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10/007,705	12/06/2001	Ronald E. Pelrine	SR11P036	9919

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EXAMINER
DOUGHERTY, THOMAS M

ART UNIT	PAPER NUMBER
2834	

DATE MAILED: 06/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/007,705	PELRINE ET AL.	
	Examiner	Art Unit	
	Thomas M. Dougherty	2834	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 December 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-91* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,11-17,20,21,23-26,30-33,35-42,45,46,48-52,56-62,64-69,73-78,80-85,87 and 91* is/are rejected.

7)☒ Claim(s) *9,10,18,19,22,27-29,34,43,44,47,53-55,63,70-72,79,86 and 88-90* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 December 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *702* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Objections

Claim 86 is objected to because of the following informalities: claim 86 is not shown separately from claim 85 but is instead embedded. In other claims there are minor typos, one common one is a misspelling of "deflection" which is occasionally spelled "defection". Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 7, 25, 64, 73 and 87 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The language of claims 7 and 87 "that is desired (cl. 7) [or] designed (cl. 87) to configured to receive input energy associated with the change in the parameter ..." is confusing. It is suspected that the Applicant intended to say "is designed or configured" which is language used in other claims. Claim 25 notes that "the voltage applied between the at least two electrodes is less than the voltage required to actuate the electromotive polymer from the first position to the second position". But claim 23 on which claim 25 depends which specifically includes the step of "deflecting the electroactive polymer from a first position to a second position". Thus claim 25 is in contradistinction to the claim on which it

depends. The result is that claim 25 is indefinite and not further evaluable at this time to the prior art.

Claims 64 and 73 each cite "the voltage source" which has no proper antecedent basis. It is suspected that claims 64 and 73 may have been intended to depend from claims 63 and 69, respectively which would provide that basis. As is, claims 64 and 73 have not been further evaluated due to this indefiniteness.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-7, 11 and 13-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Murayama et al. (US 3,903,733). Murayama et al. show (fig. 2) a sensor for detecting a change in a parameter, the sensor comprising: a transducer (1) including at least two electrodes (2, 2') in electrical communication with an electromotive polymer (PVDF, see col. 3, ll. 13-23) the transducer (1) configured such that a portion of the electromotive polymer (1) deflects in response to the change in the parameter and the portion deflection produces an electrical change in the transducer; and sensing electronics (5) in electrical communication with the at least two electrodes (2, 2') and designed or configured to detect the electrical change (col. 3 l. 66 to col. 4, l. 8).

The sensor further comprising a logic device (6) in electrical communication with the sensing electronics (5), the logic device (6) configured to quantify the portion deflection using the electrical change received by the sensing electronics (5).

The logic device (6) is further configured to quantify the change in the parameter.

The portion deflection produces an electrical impedance change (value converted by 5) in the transducer (1).

The portion deflection produces a capacitance change (inherent) in the transducer (1).

The portion deflection produces a resistance change in the transducer (1).

The sensor further comprising a coupling mechanism (4) that is configured to receive input energy associated with the change in the parameter and transfer a portion of the input energy to the electromotive polymer (1).

The transducer (1) is configured to measure mechanical deflection of an object (4) that the transducer (1) is mechanically coupled to.

The change in the parameter comprises a change in a physical property of the polymer. Note that if a voltage is applied then the polymer changes shape, or if the polymer changes shape then a voltage is generated.

The change in the physical property of the polymer (1) is the size of the polymer (1), as noted.

The transducer is a monolithic transducer.

The electromotive polymer is a dielectric elastomer (e.g. PVDF series resin, col. 3, l. 16).

One or more of the at least two electrodes (2, 2') is compliant. This is necessarily so or they would separate from the polymer.

Claims 1, 4-8, 11 and 13-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Ohigashi et al. (US 3,940,637). Ohigashi et al. show (figs. 1 and 5) a sensor for detecting a change in a parameter, the sensor comprising: a transducer (4) including at least two electrodes (4a, 4b) in electrical communication with an electromotive polymer (see ABSTRACT) the transducer (4) configured such that a portion of the electromotive polymer (4) deflects in response to the change in the parameter and the portion deflection produces an electrical change in the transducer (4); and sensing electronics (16 in fig. 5) in electrical communication with the at least two electrodes (4a,4b) and designed or configured to detect the electrical change.

The portion deflection produces an electrical impedance change (inherent).

The portion deflection produces a capacitance change (inherent) in the transducer (1).

The portion deflection produces a resistance change in the transducer (4).

The sensor further comprising a coupling mechanism (6) that is configured to receive input energy associated with the change in the parameter and transfer a portion of the input energy to the electromotive polymer (4). Note that the spring (3) provides energy to the coupling mechanism (6) and this energy is associated with the parameter change (change of force) of the input energy to the polymer (4).

The coupling mechanism comprises a stiff member (6) attached to the polymer (4) and mechanically coupled to an object (1, 3) that produces the input energy associated with the change in the parameter.

The change in the parameter (in this case the force applied to the transducer) comprises a change in a physical property (e.g. shape, voltage between the electrodes) of the polymer (4). Note that if a voltage is applied then the polymer changes shape, or if the polymer changes shape then a voltage is generated.

The change in the physical property of the polymer (1) is the size of the polymer (1), as noted.

The transducer is a monolithic transducer.

The electromotive polymer is a dielectric elastomer (ABSTRACT).

One or more of the at least two electrodes (4a, 4b) is compliant. This is necessarily so or they would separate from the polymer.

Claims 1, 20, 23, 24, 26, 30, 31-33 and 35-40 are rejected under 35 U.S.C. 102(b) as being anticipated by Scheinbeim et al. (US 5,369,995). Scheinbeim et al. show (figs. 1A, 2) a method of using an electromotive polymer transducer (see ABSTRACT) which comprises at least two electrodes (14) in electrical communication with an electromotive polymer (16), the method comprising: applying a voltage difference between the at least two electrodes (via 20); deflecting the electromotive polymer (16) from a first position to a second position; and detecting an electrical change in the transducer (16) resulting from the deflection from the first position to the

second position. Note that although the input signal is an AC signal, deflection occurs still from first to second positions.

The method of further comprising quantitatively converting (see col. 9, ll. 60-63) the electrical change to the deflection from the first position to the second position.

The method further comprising removing charge from the at least two electrodes during the deflection from the first position to the second position (via output lines 22).

The method further comprising controlling rate of moving charge to and from the polymer. This is dependent ultimately on the input frequency.

The method wherein the voltage applied between the at least two electrodes (input electrodes connected to lines 20) is an AC voltage.

The voltage applied between the at least two electrodes is between about 1mV and about 10,000 V. Note that the ultimate output signals are digital signals and these are typically 5v.

The method wherein detecting the electrical change comprises detecting one of a capacitance change and a resistance change in the transducer. Note that as charge carriers are made available at the output, capacitance is detected.

The method wherein the electromotive polymer is a dielectric elastomer.

The method wherein detecting the electrical change comprises transmitting the electrical change (via lines 22) to sensing electronics (32, 50) in electrical communication with the at least two electrodes (14).

The method wherein the sensing electronics detect a resistance change in one of the at least two electrodes. Note that the resistance changes when charge carriers are made available.

The method of wherein the sensing electronics detect a resistance change in the polymer resulting from the deflection. Again, when the polymer deflects, its properties change.

The method wherein the sensing electronics detect a capacitance change in the polymer as noted above.

The method further comprising removing charge from the at least two electrodes during deflection from the first position to the second position as noted above.

Claims 83-85 and 91 are rejected under 35 U.S.C. 102(b) as being anticipated by Porat et al. (US 6,140,740). Porat et al. shows(e.g. fig. 7a) a sensor array for detecting a change in one or more parameters, the sensor array comprising: at least one transducer comprising, at least two electrodes (38a, 40a) coupled to a first portion of at least one electromotive polymer (2, see also col. 5, lines 11-13), the at least one transducer configured such that the first portion deflects in response to a first change in the one or more parameters and the first portion deflection produces a first electrical change in the at least one transducer; at least two electrodes (38b, 40b) coupled to a second portion of the at least one electromotive polymer (2), the at least one transducer configured such that the second portion deflects in response to a second change in the one or more parameters and the second portion deflection produces a second electrical change in the at least one transducer; and sensing electronics in electrical

communication with the at least two electrodes (38a, 40a) coupled to the first portion and in electrical communication with the at least two electrodes (38b, 40b) coupled to the second portion, the sensing electronics designed or configured to detect the first and second electrical change. See the operations of the device of the invention at col. 1, ll. 5-9 and ll. 31-37.

The at least one electromotive polymer (2) is a monolithic electromotive polymer and the first portion and the second portion are both portions of the monolithic polymer (2).

The first portion of the at least one electromotive polymer responds to the first change independently to response of the second portion to the second change. Note that this is inherent in the device since the portions are spaced apart and each capable of outputting a separate voltage.

The portion deflection produces a capacitance change in the transducer (inherent).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 12, 41, 42, 45, 46 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama et al. (US 3,903,733) in view of Ohata et al. (JP2-

1662214). Given the invention of Murayama et al. as noted above, they do not specifically note sensing electronics in electrical communication with their at least two electrodes and designed or configured to detect the capacitance change.

Ohata et al. show (fig. 1) a sensor (1) for detecting a change in a parameter, the sensor comprising: a transducer (1) including at least two electrodes (not numbered in fig. 1) in electrical communication with an electroactive component, the transducer configured such that a portion of the electroactive component deflects in response to the change in the parameter and the portion deflection produces a capacitance change in the transducer; and sensing electronics (5) in electrical communication with the at least two electrodes and desired or configured to detect the capacitance change (see PURPOSE).

The capacitance change is produced in the electromotive component.

The sensing electronics are conjured to operate in an AC mode. This is an obvious requirement since the parameter changes which causes the capacitance change in the first place.

A logic device (7) in electrical communication with the sensing electronics (5), the logic device (7) configured to quantify (via 8 which is a temperature display meter) the portion deflection using the electrical change received by the sensing electronics (5).

One of the at least two electrodes is compliant. Note that this is required or the electrodes would not provide a true output.

His transducer (1f in fig. 2) is configured to measure mechanical deflection of an object (1a) that the transducer (1) is mechanically coupled to.

The mechanical deflection is a result of at least one of strain, pressure or temperature. See his title.

Ohata does not show his transducer comprising electroactive polymer. It would have been obvious to one having ordinary skill in the art to employ an electroactive polymer in the device of Ohata et al. at the time of his invention, such as is shown by Murayama et al. since this is a readily available material, is more compliant than crystal or ceramic substitutes and it provides a high piezoelectric constant (as noted by Murayama et al. at col. 3, ll. 15).

Claims 49-52 and 56-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gastgeb et al. (US 4,870,868) in view of Conrey et al. (US 4,257,594). Gastgeb describes succinctly how the Conrey invention operates. He notes at col. 1, line 64 to col. 2, line 2, a sensor for detecting a change in a parameter, the sensor comprising: a transducer which deflects in response to the change in the parameter and the portion deflection and produces a resistance change in the transducer; and sensing electronics in electrical communication with it and designed or configured to detect the resistance change. The sensing electronics also detect a voltage change in response to the resistance change in the transducer. Conrey et al. show (fig. 12) a logic device (e.g. circuit of 141, 148, 159, 152) in electrical communication with the sensing electronics (D_{1A}), the logic device configured to quantify (via sample and hold circuitry 148) the portion deflection using the voltage change received by the sensing electronics (D_{1A}). Note in Conrey et al. that their figure

13 at least shows elements (189, 186) includes electronics which operate in a DC mode.

The description does not include at least two electrodes in electrical communication with an electromotive polymer. However, in his own invention he shows (fig. 5) an electroactive polymer (col. 3, ll. 42-45) including at least two electrodes (514, 516) in electrical communication with an electromotive polymer (512). His at least two electrodes (514, 516) have a conductance greater than the electroactive polymer. Given the operations of his device, it is clear that his electrodes must be compliant. See figure 2 for example where 214 and 216 are shown in a closed U-shaped configuration. He doesn't explicitly state that his invention detects a change in resistance. It would have been obvious to one of ordinary skill in the art to employ the electroactive polymer with electrodes in the device of Gasteb's prior art as described above, because as noted, the piezoelectric or piezoresistive elements are "wound", as such, an electroactive polymer such as is shown for use by Gasteb is capable of being wound. Additionally, it is readily available, able to be formed and very versatile in its applications. A deflection in the in prior art invention with polymer would produce a resistance change in one of the at least two electrodes. The portion deflection would likewise produce a resistance change in the electromotive polymer resulting from the deflection.

Claims 60-62, 65-69, 74-78 and 80-82 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gastgeb et al. (US 4,870,868) in view of Conrey et al. (US 4,257,594). Given the combined invention of Gastgeb et al. and Conrey et al. as noted

above, Conrey et al. also show (fig. 13) sensing electronics that communicate with the transducer using a wireless communication. Conrey et al. also show a coupling mechanism (e.g. strings 14 in fig. 2) that is designed or configured to receive input energy associated with the change in the parameter and transfer a portion of the input energy to the electroactive elements (e.g. D_{1A}). In both Conrey et al. and Gastgeb et al. have a change in capacitance in the electroactive polymer when the impedance changes since when deflected, the amount of charge available depends on the amount of deflection. This translates into a voltage change, in other words as the amount of charge carriers between electrodes changes, so must the voltage change.

Claims 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Murayama et al. (US 3,903,733) in view of Conrey et al. (US 4,257,594). Given the invention of Murayama et al. and Conrey et al. as noted above, Conrey et al. further show (fig. 13) sensing electronics which communicate with the transducer using a wireless communication, while Murayama et al. do not show this. It would have been obvious to one of ordinary skill in the art to employ the electroactive polymer with its electrodes in the device of Conrey et al. at the time of their invention because it could be wound. Additionally, it is readily available, able to be formed and very versatile in its applications. A deflection in the in prior art invention with polymer would produce a an electrical change that is detectable.

Allowable Subject Matter

Claims 9, 10, 18, 19, 22, 27-29, 34, 43, 44, 47, 53-55, 63, 70-72, 79, 86 and 88-90 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The prior art fails to show or fairly suggest a coupling mechanism which is conductive in a device in which sensing electronics detect electrical change in a transducer, which change is due to application of the coupling mechanism on the transducer. The prior art fails to show or fairly suggest an electoractive polymer transducer which is configured with sensing means that sense an electrical change in the polymer due to deflection and in which the electrodes comprise one of a colloidal suspension, a conductive grease, and a mixture of ionically conductive materials, a textured electrode, a high aspect ratio carbon material and a conductive polymer. The prior art fails to show or fairly suggest an electoractive polymer transducer which is configured with sensing means that sense an electrical change in the polymer due to deflection and in which a resistor controls rat of charge moved to and from the polymer.

The prior art also fails to show or fairly suggest a method of using an electroactive polymer which involves applying a voltage to its electrodes thereby deflecting it and detecting an electrical change as a result of the deflection, wherein the deflection from one position to a second position is associated with a change in a parameter of an object that the transducer is coupled to.

The prior art fails to show or fairly suggest use of a prestrained electroactive polymer or the step of prestraining the electroactive polymer before using it wherein the electroactive polymer includes other steps of having a voltage applied to its electrodes thereby deflecting it and detecting an electrical change as a result of the deflection.

The prior art fails to show or fairly suggest a sensor including a transducer with electrodes, which transducer includes at least tow electrodes in electrical communication with an electroactive polymer, whereby the polymer deflects due to a change in a parameter and that deflection in at least a portion of it produces a capacitance change in the transducer and the capacitance change is detected by sensing electronics wherein the electrodes have a resistance approximately less than about 10% of the electoractive polymer resistance. The prior art also fails to show or fairly suggest the structure such that its electrodes serve the purpose also of voltage application to the polymer. The prior art likewise fails to show or fairly suggest the above structure in which the sensing electronics comprise a high resistance resistor in series with the at least two electrodes.

The prior art fails to show or fairly suggest a transducer of two electrodes and an electroactive polymer wherein sensing electronics detects a resistance change when the transducer is deflected due to a change in a parameter wherein the electrodes also serve the purpose of providing voltage to the transducer. The prior art fails to show or fairly suggest a transducer of two electrodes and an electroactive polymer wherein sensing electronics detect a resistance change when the transducer is deflected due to

a change in a parameter wherein a resistor controls a rate of moving charge to and from the polymer.

The prior art fails to show or fairly suggest a transducer of two electrodes and an electroactive polymer wherein sensing electronics detects a resistance change when the transducer is deflected due to deflection of the polymer in response to the change in a parameter and which electrodes are carbon tendrils.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The remaining prior art reads on at least some aspects of the claimed invention.

Direct inquiry concerning this action to Examiner Dougherty at (703) 308-1628.

tmd

June 2, 2003